7. Samplers

Objectives

- Define the **processes involved in samplers and sampling**
- Consider the **historical basis** for sampling
- Identify a **number of sample manipulation techniques**

Skills Development

- Numeracy (bit depth & sample rate)

Key Words

Mellotron
Destructive Editing
Multisampling
Velocity Layering
Keyboard Tracking
Sample Rate
Bit Depth
Normalisation
Looping
Stuttering & Gapping
Progressive Diminution
Time Stretch / Pitch Shift
Reversing
Phase Inversion

7. Samplers

- Sampling is when you take **a part of a song, single note or sound** and **reuse it in another context**.

- It is common to use a sampler to **either record, manipulate or playback** one of these pieces of audio material (or any combination of the three)

7. Samplers

AKAI S900 Sampler

7. Samplers

- Originally in the 1960s, samplers used **tape loops**.
- To change the pitch on a **tape-based recording**, the tape was played **faster or slower**.
- However, unfortunately, tapes were subject to **hiss, wow and flutter,** and **degradation.**

7. Samplers

- The **mellotron** was a tape-based sampler with loops attached to each key used by The Beatles.

7. Samplers

- Sampling was later extensively **used in hip hop** (1970s and 1980s) using **turntables**
- Drum machines **used early sampling technology** because the samples required were short and did not require pitch shifting.
- Modern day samplers are **digital,** and often triggered using MIDI

7. Samplers

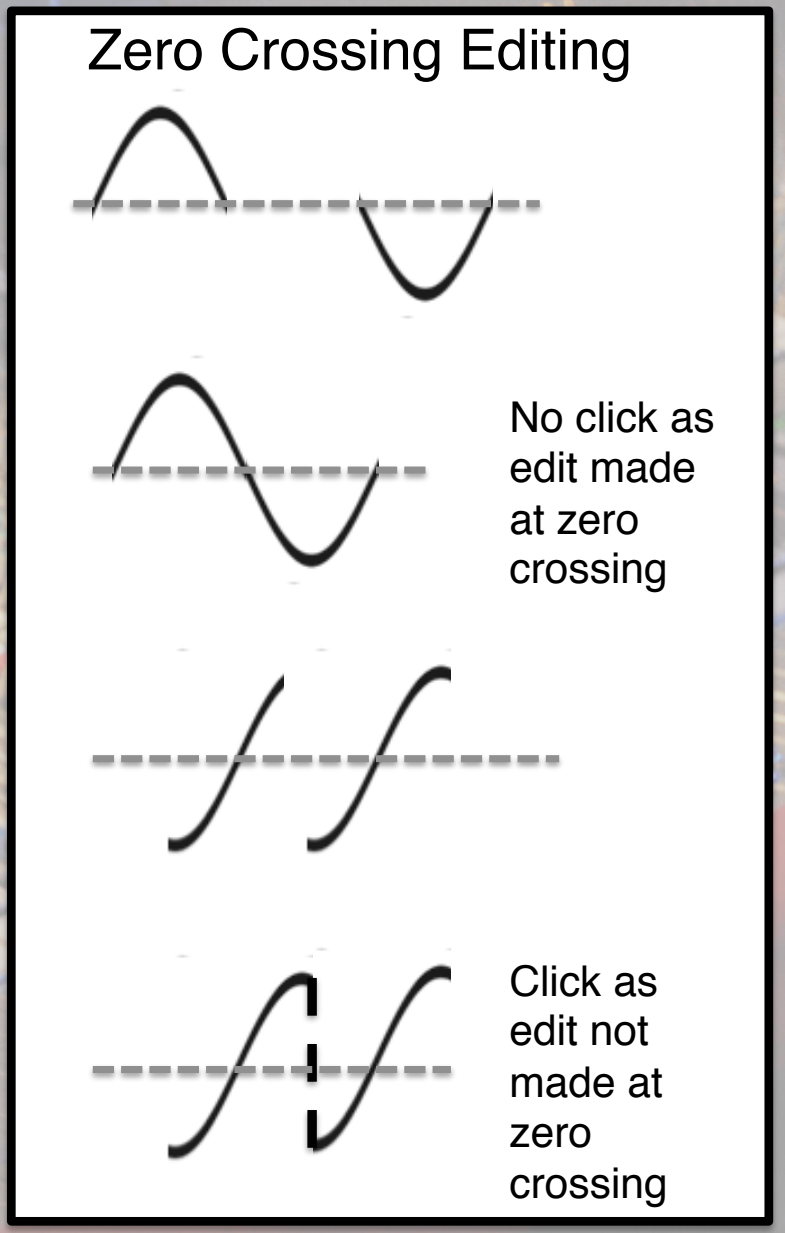
- In modern day samplers, it is noticeable when a sound is **pitch shifted beyond a few tones** (when this is done in relation to a keyboard, we call it **‘keyboard tracking’).**

- **Multisampling** is used to overcome this, ensuring samples are only used over a limited range.

- **Velocity layering is** used to change the sample depending on how hard the key is played

Zero Crossing Editing

- It is important to ensure samples are edited at a **zero-crossing point** to avoid a click or a glitch;
- Another solution is to use crossfade looping



Sample Manipulations

Loop
Repeats the sample

Normalise
Increases the volume to the maximum without distorting

Stuttering
Repeating small parts of the sample

Gapping
Adding spaces between small parts of the sample

Time Stretch
Extending or reducing the time of the sample independently from its pitch

Pitch Shift
Changing the pitch of a sample independently from its length

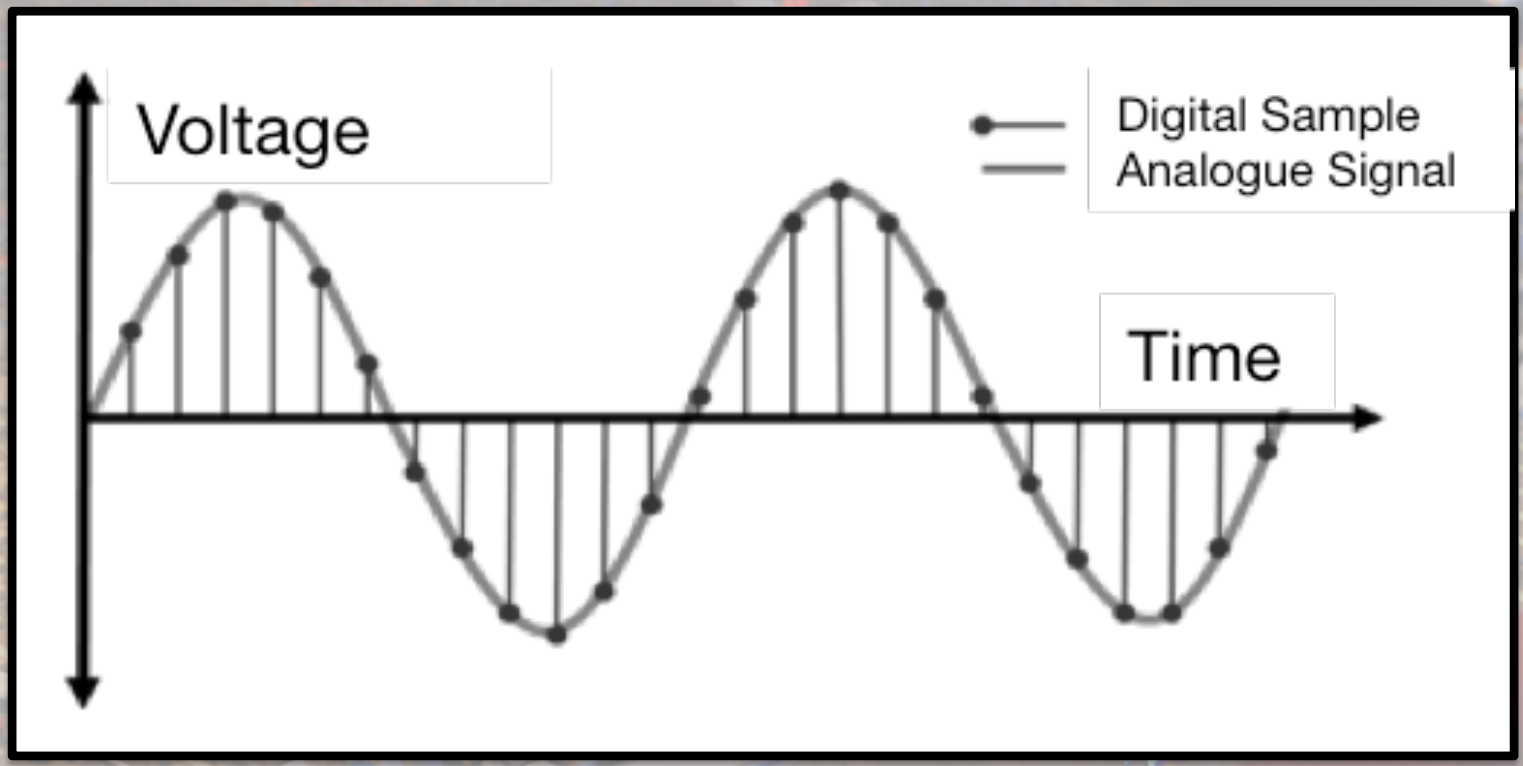
Reverse
Playing the audio data of sample backwards

Phase Invert
Flips the waveform so peaks become troughs and vice versa

Sample Rate and Bit Depth

- **Sample rate** and **bit depth** are measurements associated with digital audio and sampling
- The bit depth refers to the **number of possible amplitude measurements**
- The bit depth of the system below is **8 bit**
- The sample rate is the number of **amplitude measurements taken per second**

Sample Rate and Bit Depth



Digital Sampling

- When an analogue signal is sampled, we end up with a **stream of numbers which make up the digital signal**
- This is usually measured in **binary code (0 & 1)**
- A common **bit depth** for high quality sampling and CD audio is 16 bit
- This means that there are **2^{16} possible amplitude measurements** (65536)

Digital Sampling

- A common **sample rate** for high quality sampling and CD audio is 44100Hz
- This caters to **Nyquist's Theorum,** which states that the sample rate is **twice the highest frequency captured.**
- Since the human hearing range is between **20Hz and 20000Hz, this** means that high quality sampled audio and CD audio is able to **capture all frequencies we can hear.**